

METHOD FOR PRODUCING COMPOSITE MATERIALS SUCH AS
THERMOPLASTIC RESINS WITH MINERAL AND/OR VEGETABLE
FILLERS

Technical Field

- 5 The present invention relates to a method for producing composite materials, such as thermoplastic resins with mineral and/or vegetable fillers.

Background Art

- 10 A problem frequently encountered in the manufacture of articles made of thermoplastic resins filled with mineral and/or vegetable fillers is related to the possibility to achieve homogeneous and uniform mixing of the thermoplastic material and of the added mineral and/or vegetable elements, which can be constituted by powder, fibers, waste and so forth.

- 15 The solutions currently used do not allow to achieve intimate mixing between the filler and the thermoplastic material, and therefore discontinuities and weak regions can occur subsequently in the articles manufactured using the resulting composite material, leading to products of distinctly lower quality.

Disclosure of the Invention

- 20 The aim of the invention is to solve the above described problem by providing a method for producing composite materials, such as thermoplastic resins with mineral and/or vegetable fillers, that allows to obtain complete and uniform mixing between the resin and the fiber, achieving complete wetting of the fibers and total elimination of internal air.

- 25 Within this aim, an object of the invention is to provide a method that allows to avoid degradation of the resins and of the fibers that inevitably occurs when there is a prolonged contact between the melted polymer and the filler and/or fiber.

- 30 Another object of the present invention is to provide a method that allows to increase significantly the percentage of mineral and/or vegetable fillers, in powder or fiber form, without thereby leading to a particular

degradation of the manufactured article produced with the composite material.

Another object of the present invention is to provide a method that can be obtained with a series of operating steps that can be performed with
5 equipment generally used and is also particularly advantageous from a merely economical point of view.

This aim and these and other objects that will become better apparent hereinafter are achieved by a method for producing composite materials, such as thermoplastic resins with mineral and/or vegetable fillers,
10 characterized in that it consists in feeding a mineral and/or vegetable filler, preheating said filler, feeding a melted thermoplastic resin onto said filler, introducing the mixture of said filler and said thermoplastic resin in an extruder, subjecting the mixture to high compression, producing a high partial vacuum, and compressing the mixture in an extrusion head, out of
15 which the material to be subjected to subsequent treatments flows.

Brief Description of the Drawings

Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of a method for producing composite materials, such as
20 thermoplastic resins with mineral and/or vegetable fillers, illustrated by way of non-limiting example with the aid of the accompanying drawings, wherein:

Figure 1 is a schematic view of an apparatus for carrying out the method;

25 Figure 2 is a schematic view of a profile head for obtaining finished articles, which can be arranged at the outlet of the extrusion head;

Figure 3 is a sectional view of a sheet head that feeds a calender in order to obtain sheets of different thicknesses;

Figure 4 is a sectional view of a press with molds being fed with
30 amounts of material that have a set weight and are then pressure-molded or

vacuum-formed.

Ways of carrying out the Invention

With reference to the figures, an apparatus, generally designated by the reference numeral 1, is shown which has a body 2 inside which there is an
5 extrusion screw that is generally designated by the reference numeral 3.

It is also optionally conceptually possible to use a twin-screw extruder instead of a single-screw extruder.

A first particularity of the invention consists in that the extrusion screw 3 has a first part, designated by the reference numeral 4, that can rotate
10 inside a first cylindrical body 5 on which first heating means 6 act.

In the initial portion of the part 4 there is a hopper for loading the thermoplastic resin, which is designated by the reference numeral 10 and introduces metered quantities of material which are plasticized and then melted in order to be introduced in an injection channel 11 that has the
15 particularity of introducing at least part of the thermoplastic resin directly at the end portion of a feeder 20 of mineral and/or vegetable fillers, which can be in powder or fiber form, such feeder having a feed screw 21 that draws from a loading hopper 22.

There are also preheating means 23 that are adapted to bring the mineral
20 and/or vegetable filler to a preset temperature that can be selected from 20 to 160 degrees.

As mentioned earlier, a particularly innovative solution consists in that the melted thermoplastic resin is introduced at the end portion of the feed screw 21, so that the loads are wet by the plastic material before
25 introduction in the extruder.

This allows to eliminate a larger amount of gas, and the fillers, which are not yet compacted, are coated in depth and, due to the high temperature to which they are subjected, the residual humidity of the filler is eliminated fully and exits upward, along the feed screw 21, further heating the fillers
30 that follow along the feed.

The thermoplastic resin mixed with the fillers is introduced in the second portion 30 of the extrusion screw, where it undergoes, in an initial region, a first high compression that wets the filler and further expels the residual gases, which are conveyed outside by means of a first degassing vent 31.

5 After the high compression step, the thermoplastic resin mixed with the fillers is introduced in a mixer 35, which in practice is provided by means of a plurality of axial channels 36 that greatly reduce the cross-section and consequently increase the exposed useful surface of the mixture between plastic materials and fillers, enhancing the degassing step and further
10 facilitating the wetting action.

At the output of the mixer 35, the product is subjected to a step of high expansion in the decompression portion 40, where a second degassing vent 41 is provided.

The region of high partial vacuum in practice causes the mixture to roll
15 and relax, removing more easily any remaining gases, which can exit from the second degassing vent 41.

Downstream of the decompression portion 40 there is an extrusion portion 50, where the material is compressed inside an extrusion head 51, which produces the outflow of the material to be subjected to optional
20 further treatments.

It should be added to the above that it is possible to provide an auxiliary inlet 60, which allows to introduce a second thermoplastic resin to be mixed with the thermoplastic resin that is fed in the first portion; it is also possible to send the thermoplastic resin fed in the first portion only partially
25 to the end of the loading hopper, in an amount that is in any case greater than 20%, while the remaining part of the material is fed directly into the second portion of the extrusion screw.

It should be further added that the fed resin is provided in percentages from 25 to 70% inside the first portion of the extrusion screw, while the
30 second portion, which has at least twice the cross-section of the first one,

also includes the filler in a percentage from 75 to 30%.

The filler is preferably constituted by mineral or vegetable elements in powder or fiber form, with a length from 3 to 20 mm.

It is also possible to introduce treatment waste up to a maximum of 30%
5 by using the feeder 20.

Schematically, it is possible to indicate that the first portion of the extrusion screw has an axial extension of approximately 20 diameters, while the second portion where compression and partial vacuum occur has a length of approximately 14 diameters, including the end portion for final
10 extrusion.

At the output of the extrusion head it is possible to provide, as shown in Figure 2, a profile head 70 that allows to directly obtain finished manufactured articles that are extruded directly at the outlet of the extrusion head.

15 According to what is shown in Figure 3, it is possible to provide a sheet head 72, downstream of which there are calendering rollers 73.

With reference to Figure 4, it is possible to provide an extrusion head 76, from which a worm of product 77 having a preset weight exits, such worm being introduced directly into a press 78, the molds of which allow to
20 manufacture the intended articles.

It is also possible to provide a spaghetti head for producing granules.

From what has been described above it is therefore evident that the invention achieves the intended aim and objects, and in particular the fact is stressed that an innovative technique is used which consists in introducing
25 the thermoplastic resin in a region that is external with respect to the extrusion screw so that it is easier to achieve intimate mixing.

It should be added to the above that although in the examples cited above the first portion where the melting of the thermoplastic resin occurs is in axial alignment with the same extrusion screw and arranged thereon, it is
30 obviously possible to provide a separate extrusion screw that feeds the

thermoplastic material at the end of the feed portion of the feeder of mineral and/or vegetable fillers.

The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

5 All the details may further be replaced with other technically equivalent elements.

Furthermore, the individual characteristics, given in relation to specific examples, may actually be interchanged with other different characteristics that exist in other examples of embodiments.

10 In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements.

The disclosures in Italian Patent Application No. MI2002A002736 from which this application claims priority are incorporated herein by reference.

CLAIMS

1. A method for producing composite materials, such as thermoplastic resins with mineral and/or vegetable fillers, characterized in that it consists in feeding a mineral and/or vegetable filler, preheating said filler, feeding a melted thermoplastic resin onto said filler, introducing the mixture of said filler and said thermoplastic resin in an extruder, subjecting the mixture to high compression, producing a high partial vacuum, and compressing the mixture in an extrusion head, out of which the material to be subjected to subsequent treatments flows.
2. The method according to claim 1, characterized in that said mineral and/or vegetable filler is heated to a temperature from 20 to 160°.
3. The method according to the preceding claims, characterized in that said resin is present in a percentage from 25 to 70% of the material being obtained and said filler is present in a percentage from 75 to 30%.
4. The method according to one or more of the preceding claims, characterized in that degassing is performed during the high compression step.
5. The method according to one or more of the preceding claims, characterized in that said thermoplastic resin mixed with said filler is introduced in a mixer that is adapted to increase the exposed surface of said mixture for degassing and wetting the filler.
6. The method according to one or more of the preceding claims, characterized in that a second degassing is performed when said high partial vacuum step is performed.
7. The method according to one or more of the preceding claims, characterized in that it provides for the introduction of processing waste in a maximum quantity of 30%.
8. The method according to one or more of the preceding claims, characterized in that said filler is formed by powder or fibers.
9. The method according to one or more of the preceding claims,

characterized in that said fibers of said filler have a length from 3 to 20 mm.

10. The method according to one or more of the preceding claims, characterized in that said extrusion screw, in the step for melting the thermoplastic resin, has an axial extension of substantially 20 diameters, and the second compression and partial vacuum portion has a length of substantially 14 diameters including the end portion for final extrusion.

11. The method according to one or more of the preceding claims, characterized in that said thermoplastic resin is fed by means of an extrusion screw that is provided in axial alignment with the extruder, at least part of said melted thermoplastic resin being introduced in said filler before introduction in said extruder, the remaining part being introduced in said extruder.

12. The method according to one or more of the preceding claims, characterized in that said melted thermoplastic resin is fed by an extrusion screw that is separate with respect to the extrusion screw for processing the mixture of thermoplastic resin and filler.

13. An apparatus for producing composite materials such as thermoplastic resins with mineral and vegetable fillers, characterized in that it comprises an extrusion screw that has a first part for plasticizing and melting a thermoplastic resin, said extruder being connected, at the end of said first part, to the end portion of a feeder of mineral and/or vegetable fillers for mixing the filler and the thermoplastic resin before introduction in the extruder.

14. The apparatus according to claim 13, characterized in that said extrusion screw has a second portion that forms a region of high compression and then a partial vacuum region.

15. The apparatus according to one or more of the preceding claims, characterized in that it comprises, between said high compression region and said high partial vacuum region, a mixer that is adapted to increase the

exposed surface of said mixture.

16. The apparatus according to one or more of the preceding claims, characterized in that said mixer has a plurality of channels that are arranged substantially parallel to the axial direction and form a reduced cross-section
5 with respect to the useful upstream cross-section for feeding the material.

17. The apparatus according to one or more of the preceding claims, characterized in that it comprises an auxiliary inlet for introducing a second thermoplastic resin.

18. The apparatus according to one or more of the preceding claims,
10 characterized in that it comprises, at the outlet of said extrusion head, a profile head for obtaining finished articles.

19. The apparatus according to one or more of the preceding claims, characterized in that it comprises, at the outlet of said extrusion head, a sheet head, downstream of which calendering rollers are arranged.

15 20. The apparatus according to one or more of the preceding claims, characterized in that comprises, downstream of said extrusion head, a press with molds for forming manufactured articles.

21. The apparatus according to one or more of the preceding claims, characterized in that it comprises a spaghetti head for producing granules.

ABSTRACT

A method for producing composite materials, such as thermoplastic resins with mineral and/or vegetable fillers, consisting in feeding a mineral and/or vegetable filler, preheating the filler, feeding a melted thermoplastic resin onto the filler, introducing the mixture of the filler and the thermoplastic resin in an extruder, subjecting the mixture to high compression, producing a high partial vacuum, and compressing the mixture in an extrusion head, out of which the material to be subjected to subsequent treatments flows.